Serial No.	Question	CO	Bloom's Taxonomy Level	Difficulty Level	Competitive Exam Question Y/N	Area	Topic	Unit	Marks
1	Show that v is an eigenvector of A and find the corresponding eigenvalue. $A=\begin{bmatrix}0 & 3\\ 3 & 0\end{bmatrix}, \mathbf{v}=\begin{bmatrix}1\\ 1\end{bmatrix}$	3	K2	L	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	2
2	Show that v is an eigenvector of A and find the corresponding eigenvalue $A=\begin{bmatrix}3 & 0 & 0\\ 0 & 1 & -2\\ 1 & 0 & 1\end{bmatrix}, \mathbf{v}=\begin{bmatrix}2\\ -1\\ 1\end{bmatrix}$	3	K2	M	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
3	Show that λ is an eigenvalue of A and find one eigenvector corresponding to the eigenvalue. $A=\begin{bmatrix}2 & 2\\ 2 & -1\end{bmatrix}, \lambda=3$	3	K2	L	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	2
4	Show that λ is an eigenvalue of A and find one eigenvector corresponding to the eigenvalue. $A=\begin{bmatrix}1 & 0 & 2\\ -1 & 1 & 1\\ 2 & 0 & 1\end{bmatrix}, \lambda=-1$	3	K2	M	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
5	Define characteristic polynomial for a square matrix.	3	K1	L	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	2
6	Define algebraic and geometric multiplicity of the eigenvalue.	3	K1	L	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	2
7	Compute (*a*) the characteristic	3	K2	M	N	Eigenv	Eigenv	3	6

	polynomial of *A*, (*b*) the eigenvalues of *A*, (*c*) a basis for each eigenspace of *A*, and (*d*) the algebraic and geometric multiplicity of each eigenvalue. $A=\begin{bmatrix}1 & 3\\ -2 & 6\end{bmatrix}$					alue proble m	alue, Eigenv ector		
8	Compute (*a*) the characteristic polynomial of *A*, (*b*) the eigenvalues of *A*, (*c*) a basis for each eigenspace of *A*, and (*d*) the algebraic and geometric multiplicity of each eigenvalue. $A=\begin{bmatrix}2 & 1\\ -1 & 0\end{bmatrix}$	3	K2	M	N	Eigenv alue proble m	Eigenv alue, Eigenv ector	3	6
9	Compute (*a*) the characteristic polynomial of *A*, (*b*) the eigenvalues of *A*, (*c*) a basis for each eigenspace of *A*, and (*d*) the algebraic and geometric multiplicity of each eigenvalue. $A=\begin{bmatrix}1 & 1 & 0\\ 0 & -2 & 1\\ 0 & 0 & 3\end{bmatrix}$	3	K2	H	N	Eigenv alue proble m	Eigenv alue, Eigenv ector	3	9 / 1 0
10	Compute (*a*) the characteristic polynomial of *A*, (*b*) the eigenvalues of *A*, (*c*) a basis for each eigenspace of *A*, and (*d*) the algebraic and geometric multiplicity of each eigenvalue. $A=\begin{bmatrix}1 & 0 & 1\\ 0 & 1 & 1\\ 1 & 1 & 0\end{bmatrix}$	3	K2	H	N	Eigenv alue proble m	Eigenv alue, Eigenv ector	3	9 / 1 0
11	Compute (*a*) the characteristic polynomial of *A*, (*b*) the eigenvalues of *A*, (*c*) a basis for each eigenspace of *A*, and (*d*) the algebraic and geometric multiplicity of each eigenvalue. $A=\begin{bmatrix}1 & 2 & 0\\ -1 & -1 & 1\\ 0 & 1 & 1\end{bmatrix}$	3	K2	H	N	Eigenv alue proble m	Eigenv alue, Eigenv ector	3	9 / 1 0
12	Compute (*a*) the characteristic	3	K2	H	N	Eigenv	Eigenv	3	9

	polynomial of *A*, (*b*) the eigenvalues of *A*, (*c*) a basis for each eigenspace of *A*, and (*d*) the algebraic and geometric multiplicity of each eigenvalue. $A = \begin{bmatrix} 1 & 0 & 2 \\ 3 & -1 & 3 \\ 2 & 0 & 1 \end{bmatrix}$					alue problem	alue, Eigenvector		/10
13	Show that if a matrix has non-zero eigenvalues then it is invertible.	3	K3	M	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
14	Show that an eigenvector cannot correspond to two distinct eigenvalues.	3	K3	M	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
15	Show that the eigenvalues of a symmetric matrix are all real.	3	K3	H	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
16	Show if the trace and determinant of a 3X3 matrix A are positive and negative respectively then matrix A has only one negative eigenvalue, considering all eigenvalues are real.	3	K3	H	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
17	Let A be the 2x2 matrix with elements a11 = a12 = a21= + 1 and a22 = -1. Then find the eigenvalues of the matrix A^{19}.	3	K3	M	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
18	Find the eigenvalues of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 7 \\ 0 & 0 & 3 \end{bmatrix}$.	3	K2	M	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	2
19	Consider the matrix $A = \begin{bmatrix} 2 & 3 \\ x & y \end{bmatrix}$. If the eigenvalues of A are 4 and 8 then find x and y.	3	K3	H	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
20	A matrix has eigenvalues -1 and -2. The corresponding eigenvectors are $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ and $\begin{bmatrix} 1 \\ -2 \end{bmatrix}$ respectively. Find the matrix.	3	K3	H	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
21	Show that the eigenvalues of a real	3	K3	M	Y	Eigenv	Eigenv	3	6

	skew-symmetric matrix are either zero or pure imaginary.					alue problem	alue, Eigenvector		
22	Find the minimum Eigen value of the matrix $\begin{bmatrix} 3 & 5 & 2 \\ 5 & 12 & 7 \\ 2 & 7 & 5 \end{bmatrix}$.	3	K3	M	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
23	Find the absolute value of the ratio of the maximum eigenvalue to the minimum eigenvalue of the matrix $\begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$.	3	K3	M	Y	Eigenvalue problem	Eigenvalue, Eigenvector	3	6
24	Define similar matrices.	3	K1	L	N	Diagonalization	Similar Matrix	3	2
25	Show that A and B are not similar matrices. $A = \begin{bmatrix} 2 & 1 \\ -4 & 6 \end{bmatrix}, B = \begin{bmatrix} 3 & -1 \\ -5 & 7 \end{bmatrix}$	3	K2	L	N	Diagonalization	Similar Matrix	3	2
26	Show that A and B are not similar matrices. $A = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & -1 \\ 0 & -1 & 1 \end{bmatrix}, B = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix}$	3	K2	M	N	Diagonalization	Similar Matrix	3	6
27	Determine whether A is diagonalizable and, if so, find an invertible matrix P and a diagonal matrix D such that $P^{-1}AP = D$. $A = \begin{bmatrix} 5 & 2 \\ 2 & 5 \end{bmatrix}$	3	K3	M	N	Diagonalization	Diagonalization	3	6
28	Determine whether A is diagonalizable and, if so, find an invertible matrix P and a diagonal matrix D such that $P^{-1}AP = D$. $A = \begin{bmatrix} -3 & 4 \\ -1 & 1 \end{bmatrix}$	3	K3	M	N	Diagonalization	Diagonalization	3	6
29	Determine whether A is diagonalizable and, if so, find an invertible matrix P and a diagonal matrix D such that $P^{-1}AP = D$.	3	K3	H	N	Diagonalization	Diagonalization	3	9/10

	$A=\begin{bmatrix}3&1&0\\0&3&1\\0&0&3\end{bmatrix}$								
30	Determine whether A is diagonalizable and, if so, find an invertible matrix P and a diagonal matrix D such that $P^{-1}AP=D$. $A=\begin{bmatrix}1&0&1\\0&1&1\\1&1&0\end{bmatrix}$	3	K3	H	N	Diagonalization	Diagonalization	3	9/10
31	Determine whether A is diagonalizable and, if so, find an invertible matrix P and a diagonal matrix D such that $P^{-1}AP=D$. $A=\begin{bmatrix}1&0&0\\2&2&1\\3&0&1\end{bmatrix}$	3	K3	H	N	Diagonalization	Diagonalization	3	9/10
32	Determine whether A is diagonalizable and, if so, find an invertible matrix P and a diagonal matrix D such that $P^{-1}AP=D$. $A=\begin{bmatrix}1&2&1\\-1&0&1\\1&1&0\end{bmatrix}$	3	K3	H	N	Diagonalization	Diagonalization	3	9/10
33	Compute $\begin{bmatrix}-4&6\\-3&5\end{bmatrix}^{9}$.	3	K3	H	N	Diagonalization	Power Matrix	3	6
34	Compute $\begin{bmatrix}1&1&1\\0&-1&0\\0&0&-1\end{bmatrix}^{2018}$.	3	K3	H	N	Diagonalization	Power Matrix	3	9/10
35	Find all real values of k for which $(i)\begin{bmatrix}1&1\\0&k\end{bmatrix}$, $(ii)\begin{bmatrix}1&k\\0&1\end{bmatrix}$ are diagonalizable.	3	K3	H	N	Diagonalization	Diagonalization	3	9/10
36	Give an example of a 3X3 matrix in support of the statement, “Eigenvectors of a symmetric matrix corresponding to different eigenvalues are orthogonal”.	3	K3	H	N	Eigenvalue problem	Eigenvalue, Eigenvector	3	9/10

37	Compute e^A for $\begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$.	3	K3	H	N	Diagonalization	Diagonalization	3	9/10
38	Define real inner product space and give an example.	3	K1	M	N	Inner product space	Inner product space	3	2
39	Let $u = (a, b)$ and $v = (c, d)$ be two vectors in R^2. Show that $< u, v > = (2ac + 3bd)$ defines an inner product.	3	K2	M	N	Inner product space	Inner product space	3	6
40	Let $u = (a, b)$ and $v = (c, d)$ be two vectors in R^2. Show that $< u, v > = (ac - bd)$ is not an inner product.	3	K2	M	N	Inner product space	Inner product space	3	2
41	Define norm (Euclidean norm).	3	K1	L	N	Inner product space	Inner product space	3	2
42	Define orthogonal set in $\mathbf{R}^n$.	3	K1	L	N	Inner product space	Orthogonal set	3	2
43	Show that{v1,v2,v3} is an orthogonal set in R^3 if v1=(2,1,-1), v2=(0,1,1), v3=(1,-1,1)	3	K2	M	N	Inner product space	Orthogonal set	3	2
44	Define orthogonal basis.	3	K1	L	N	Inner product space	Orthogonal basis	3	2
45	Find an orthogonal basis for the subspace W of $\mathbf{R}^3$ given by $W = \left\{ \begin{bmatrix} x \\ y \\ z \end{bmatrix} : x - y + 2z = 0 \right\}$	3	K2	M	N	Inner product space	Orthogonal Basis	3	6
46	Define orthonormal set in $\mathbf{R}^n$.	3	K1	L	N	Inner product space	Orthogonal Basis	3	2
47	Show that {q1, q2} is an orthonormal set in R^3 if $q1 = \left(\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right), q2 = \left(\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{1}{\sqrt{6}}\right)$	3	K2	M	N	Inner product space	Orthonormal set	3	2
48	Define orthonormal basis.	3	K1	L	N	Inner	Orthog	3	2

						product space	onal Basis		
49	Define orthogonal matrix.	3	K1	L	N	Inner product space	Orthogonal matrix	3	2
50	Determine the matrix $A=\begin{bmatrix} \frac{1}{3} & \frac{1}{2} & \frac{1}{5} \\ \frac{1}{3} & -\frac{1}{2} & \frac{1}{5} \\ -\frac{1}{3} & 0 & \frac{2}{5} \end{bmatrix}$ is orthogonal. If it is, find its inverse.	3	K2	M	N	Inner product space	Orthogonal matrix	3	6
51	Determine the matrix $A=\begin{bmatrix} \cos\theta\sin\theta & -\cos\theta & -\sin^2\theta \\ \cos^2\theta & \sin\theta & -\cos\theta\sin\theta \\ \sin\theta & 0 & \cos\theta \end{bmatrix}$ is orthogonal. If it is, find its inverse.	3	K2	M	N	Inner product space	Orthogonal matrix	3	6
52	Define orthogonal projection.	3	K1	L	N	Inner product space	Orthogonal Projection	3	2
53	Let $W=\text{span}(\mathbf{x}_1,\mathbf{x}_2)$, where $\mathbf{x}_1=\begin{bmatrix}1\\1\\0\end{bmatrix}$ and $\mathbf{x}_2=\begin{bmatrix}-2\\0\\1\end{bmatrix}$. Construct an orthogonal basis for W.	3	K3	M	N	Inner product space	Orthogonal basis	3	6
54	Write the Gram-Schmidt Process.	3	K1	L	N	Inner product space	Gram-Schmidt Process	3	2
55	Apply the Gram-Schmidt Process to construct an orthogonal basis for the subspace $W=\text{span}(\mathbf{x}_1,\mathbf{x}_2,\mathbf{x}_3)$ of $\mathbf{R}^4$, where	3	K3	H	N	Inner product space	Gram-Schmidt Process	3	9/10

	$\mathbf{x}_1 = \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \end{bmatrix}, \mathbf{x}_2 = \begin{bmatrix} 2 \\ 1 \\ 0 \\ 1 \end{bmatrix}, \mathbf{x}_3 = \begin{bmatrix} 2 \\ 2 \\ 1 \\ 2 \end{bmatrix}$								
56	Find an orthogonal basis for $\mathbf{R}^3$ that contains the vector $\mathbf{x}_1 = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$. (by Gram-Schmidt Process)	3	K3	H	N	Inner product space	Gram-Schmidt Process	3	9/10
57	If the characteristic polynomial of a square matrix *M* of order 3 over real numbers is $\lambda^3 - 4\lambda^2 + a\lambda + 30, a \in \mathbf{R},$ and one eigenvalue of *M* is 2, then find the largest among the absolute values of the eigenvalues of *M*.	3	K3	H	Y	Eigenvalue	Eigenvalue	3	6
58	Let *u* and *v* be two vectors in $\mathbf{R}^2$ whose Euclidean norms satisfy $\|u\| = 2\|v\|$. What is the value of α such that $w = u + \alpha v$ bisects the angle between *u* and *v*?	3	K3	H	Y	Inner product space	angle	3	9/10
59	The two eigenvalue of a real square matrix of order 3 are 3 and $\left(2+\sqrt{-1}\right)$. Find the determinant of the matrix.	3	K3	H	Y	Eigenvalue	Determinant	3	6
60	Find the determinant of $\left(A^{-1}\right)^T$ if eigenvalues of *A* are 1, 2 and 4.	3	K3	H	Y	Eigenvalue	Determinant	3	6
61	Find the eigenvalues of a matrix of order n whose all entries are 1.	3	K3	H	Y	Eigenvalue	Eigenvalue	3	6
62	Find the values of *a* and *b* of the matrix $\begin{bmatrix} 1 & 4 \\ b & a \end{bmatrix}$ if the eigenvalues of the matrix are -1 and 7.	3	K3	H	Y	Eigenvalue	Eigenvalue	3	6